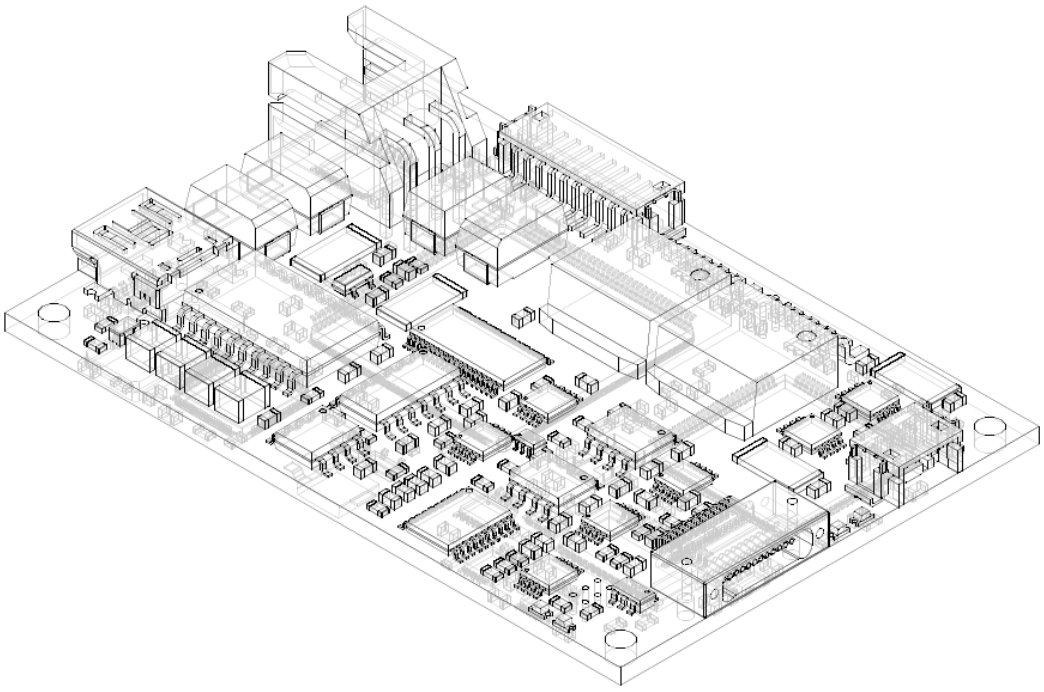
Gyro Control Unit (GCU)
User's Guide



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CONTENTS

1 Scope 5
1.1 Overview 5
1.2 Theory of Operation 6
1.3 Mechanical Interface 7
1.4 Electrical Interfaces 9
1.4.1 Power Supply Interface 10
1.4.2 Analog Interface 11
1.4.3 Digital Interface 12
1.4.3.1 Data Format 13
1.4.4 USB Interface 13
1.4.5 G-2000 Interface 13
2 SETUP 15
3 APPLYING POWER 16
3.1 LED Status Indicators 16
3.1.1 Microcontroller Status 16
3.1.2 DSP Status 16
4 Performance Analyzer 17
4.1 Performance Analyzer (Gyro Setup Program) 17
4.1.1 CAL/STATUS TAB 18
4.1.1.1 Commands 18
4.1.1.1.1 Torquer On | Off 19
4.1.1.1.2 Motor On | Off 19
4.1.1.1.3 Save Calibration 19
4.1.1.1.3.1 Path to Save Calibration Files 19
4.1.1.1.4 Send Command Button 19
4.1.1.1.5 Additional Information 19
4.1.1.1.6 Read Values from DSP 19
4.1.1.1.7 Write Values to DSP 19
4.1.1.2 Control Law Parameters 19
4.1.1.2.1 Proportional Gain, K_p 19
4.1.1.2.2 Integral Gain, K_i 20
4.1.1.2.3 Compensator Frequency 20
4.1.1.2.4 ADC Offset 20
4.1.1.2.5 DAC Offset 20
4.1.1.3 Read Values from DSP 20
4.1.1.4 Update Values 20
4.1.2 The Scope 21
4.1.2.1 Channel Enable 21
4.1.2.2 Auto Y ranging 21
4.1.2.3 Sample Rate 21

4.1.2.4 Number of Samples 21
4.1.2.5 Start | Stop....22
4.1.2.6 Connect | Disconnect 22
4.1.3 The Spectrum Analyzer....23
4.1.3.1 DATA SELECT....24
4.1.3.2 Auto-Y 24
4.1.3.3 PSDE....24
4.1.3.4 Peak Hold Enable....24
4.1.3.5 Frequency Range 25
4.1.3.6 Start | Stop....25
4.1.4 The Bode Analyzer....26
4.1.4.1 How it works....27
4.1.4.2 Axis....28
4.1.4.3 Trace Color 28
4.1.4.4 Parameters....28
4.1.4.4.1 Start Frequency 28
4.1.4.4.2 Stop Frequency....28
4.1.4.4.3 Excitation Amplitude 28
4.1.4.4.4 Sample Rate 28
4.1.4.4.5 Duration 28
4.1.4.5 Start | Stop....28
4.1.5 Notch Filter Adjustments 29
4.1.5.1 Write to DSP....29
4.1.6 Firmware Loader....31
4.1.6.1 Browse 31
4.1.6.2 Load 32
4.1.6.3 NO-OP 33
4.1.6.4 DSP Entry Point....33
4.1.6.5 Autoboot Enable 33
4.1.6.6 Firmware Release Level 33
4.1.6.7 Troubleshooting the LINK....33
4.1.7 Manufacturing Report 34
4.2 Parameter Buttons and Storage 36
5 SOFTWARE LICENSE....37
6 FAQ and Technical Support 39
6.1 Gyro Setup Software does not respond to commands....39
6.2 G-2000 Gyro is unstable after power is applied....39
6.3 Gyro not Caging....39
6.4 Mechanical Dimensions 41
6.5 Electrical Specifications....41
6.6 Environmental Specification....41

FIGURES

Figure 1 GCU2K1, Gyro Control Unit (GCU)....5
Figure 2 GCU, Block Diagram....6
Figure 3 GCU 3-Dimensional Model....6

Figure 4 GCU Board Layout, Mechanical Dimensions 7
Figure 5 GCU unit with optional heat sink 7
Figure 6 Power Supply Connector 8
Figure 7 Digital Output Connector 8
Figure 8 Analog Output Connector 8
Figure 9 Electrical Interfaces 9
Figure 10 Power Supply Connector, Illustration 10
Figure 11 Analog Output Connector 11
Figure 12 Digital Output Connector 12
Figure 13 Digital Output, SPI Data Format 13
Figure 14 G-2000 Connector 13
Figure 15 GCU Interface Connectors 15
Figure 16 GCU Unit connected to the G-2000 gyro 16
Figure 17 Cal / Status Commands, Gyro Setup 18
Figure 18 Oscilloscope Function, Gyro Setup 21
Figure 19 Spectrum Analyzer with 800Hz notch filter turn OFF 23
Figure 20 Spectrum Analyzer with 800Hz notch filter turned ON 24
Figure 21 Open Loop Response, Bode Analyzer 26
Figure 22 Bode Plot Analyzer 27
Figure 23 Notch Filter Coefficient Adjustments 29
Figure 24 Filter Coefficients 30
Figure 25 Firmware Loader Application 31
Figure 27. Browse File Function, Graphical User Interface (GUI) 32
Figure 28 Examples of a nicely tune system, Spectrum Plot 40
Figure 29 Examples of a nicely tuned system, Bode Plot 40

TABLES

Table 1. Available Firmware Files, Extension(s) 32
Table 2 Parameter Button Usage 36
Table 3 Parameter Button Usage 36
Table 4 Mechanical Dimensions 41
Table 5 Electrical Specifications 41
Table 6 Environmental Specifications 41

WARNING!!! & CAUTION!!!

Warnings and Cautions have been boxed in to bring attention to the user to proceed with caution but, only after making all of the appropriate checks and verifications. Failure to adhere to the information can have catastrophic results and can end up damaging the units beyond repair.

1 SCOPE

This manual describes the use and setup of the G-2000 Gyro Control Unit (GCU) product, Model No: GCU2K1.

1.1 OVERVIEW

The GCU2K1 gyro control unit is designed to provide digital control for the Northrop Grumman Company, G-2000 dual rate sensor products.

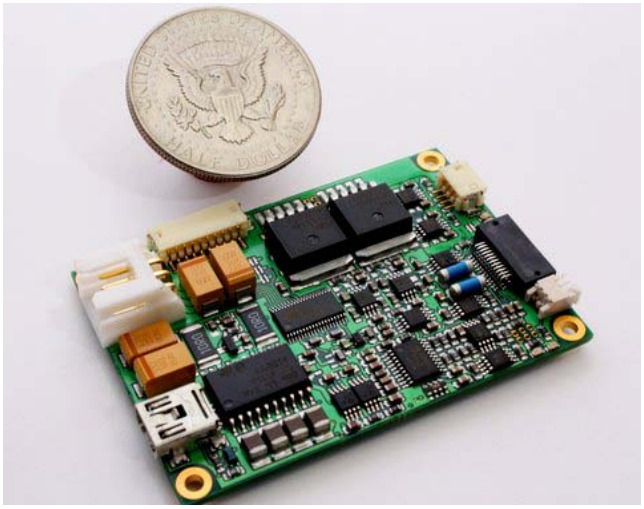

Figure 1 GCU2K1, Gyro Control Unit (GCU)

The GCU digital control unit is based on the Texas Instrument's TMS320VC33-150 Floating-Point Digital Signal Processing unit. This GCU device is responsible for calculating the complex compensation, digital low pass and notch filters, and control response. The GCU also provides the necessary stimulus and data collection to create the bode plots to determine the overall gyro performance. Tuning parameters are stored in the GCU in its on-board EEPROM and sent to the DSP once power in applied. The DSP closes the gyro control loop at over 20,000 samples per second allowing the gyro to achieve very high fidelity.

1.2 THEORY OF OPERATION

The GCU unit monitors and controls the gyroscope unit's rotary wheel displacement about the Pitch and Yaw axis. The GCU converts the sensed signal from the pickup coils into the appropriate torque commands to keep the gyro wheel in the center of its travel. The output of the system is proportional to the pitch and yaw rate inputs to the gyro. These rate values are available in both analog and digital output formats. The GCU unit provides all of the necessary spin motor start and drive signals, torque motor drive, pickoff excitation signals, and pickoff amplification for the gyro unit. Figure 2 shows the block diagram of the GCU unit.

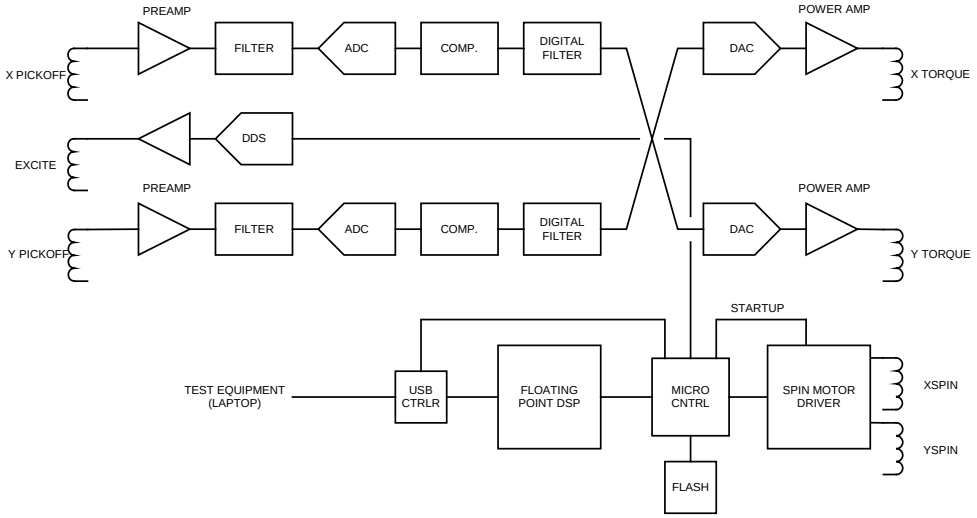

Figure 2 GCU, Block Diagram

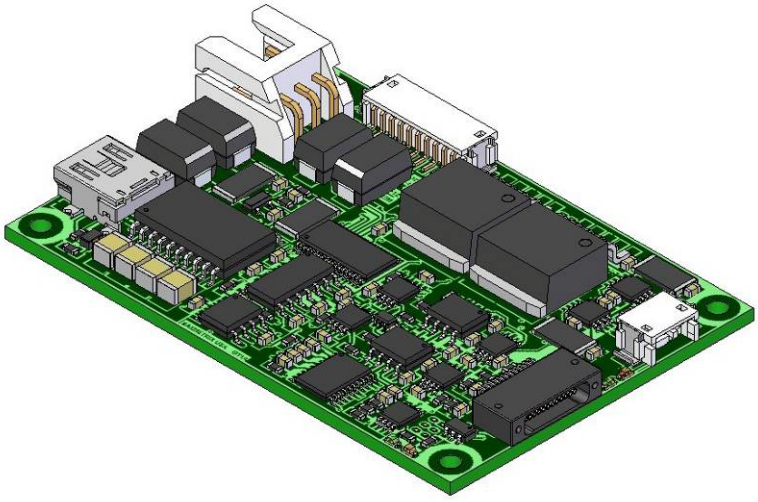

Figure 3 GCU 3-Dimensional Model

GCU Interfaces

1.3 MECHANICAL INTERFACE

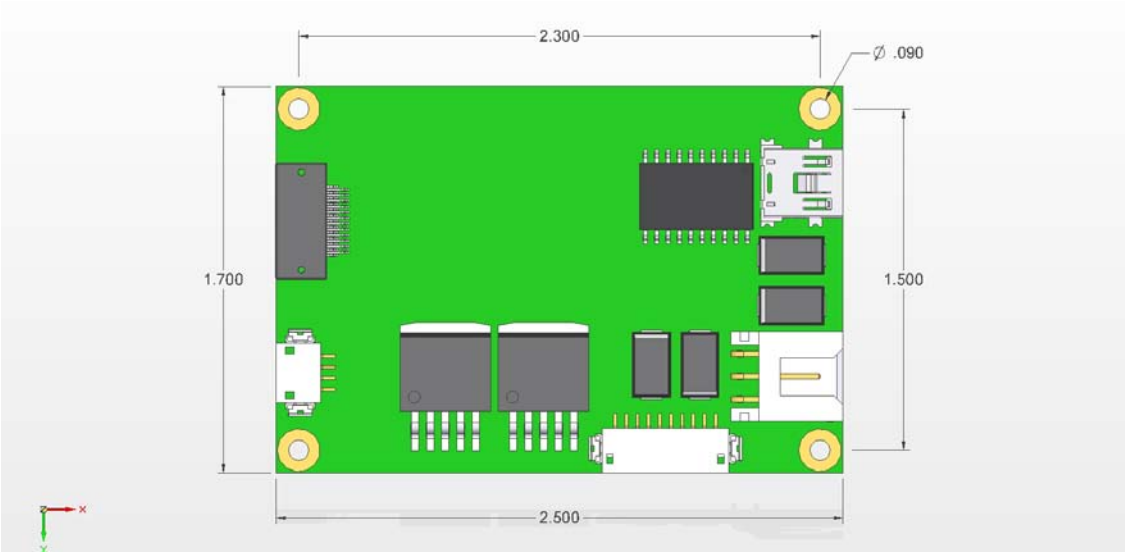

Figure 4 GCU Board Layout, Mechanical Dimensions

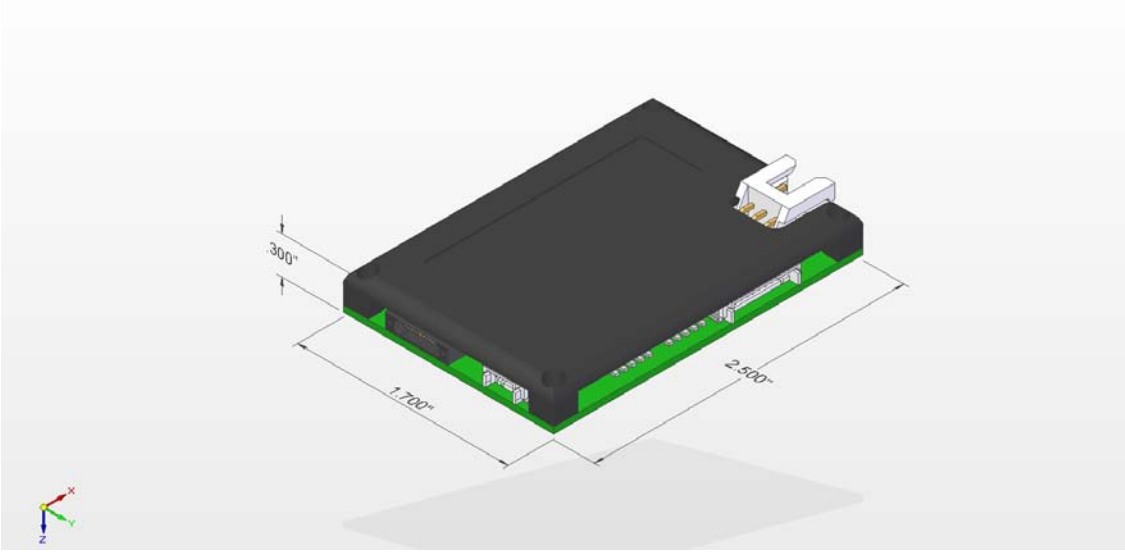

Figure 5 GCU unit with optional heat sink

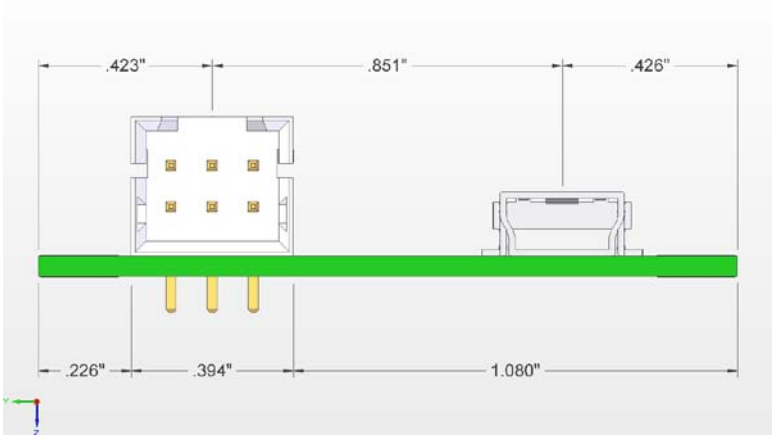

Figure 6 Power Supply Connector

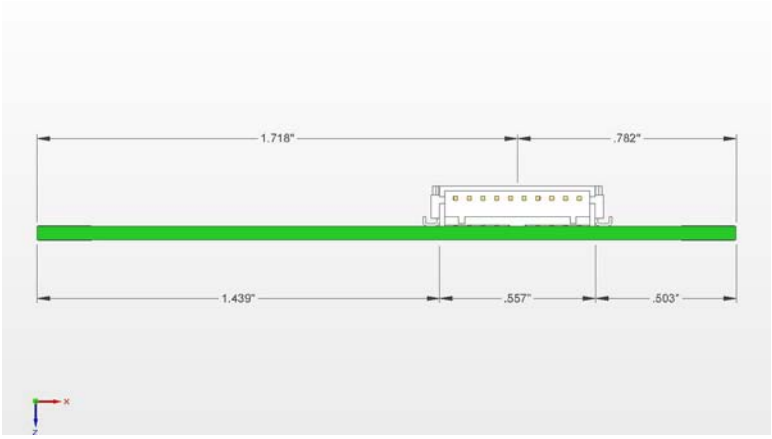

Figure 7 Digital Output Connector

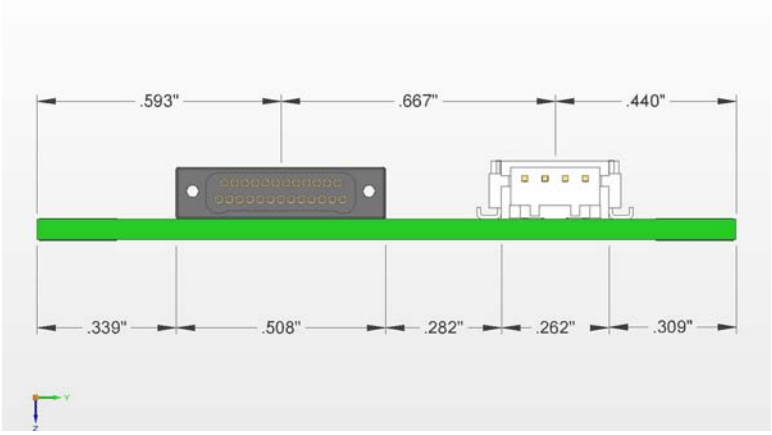

Figure 8 Analog Output Connector

1.4 ELECTRICAL INTERFACES

The GCU unit has several interface connectors for power, gyro interface, rate outputs (i.e., analog and digital), test equipment interface. The connectors are defined as follows:

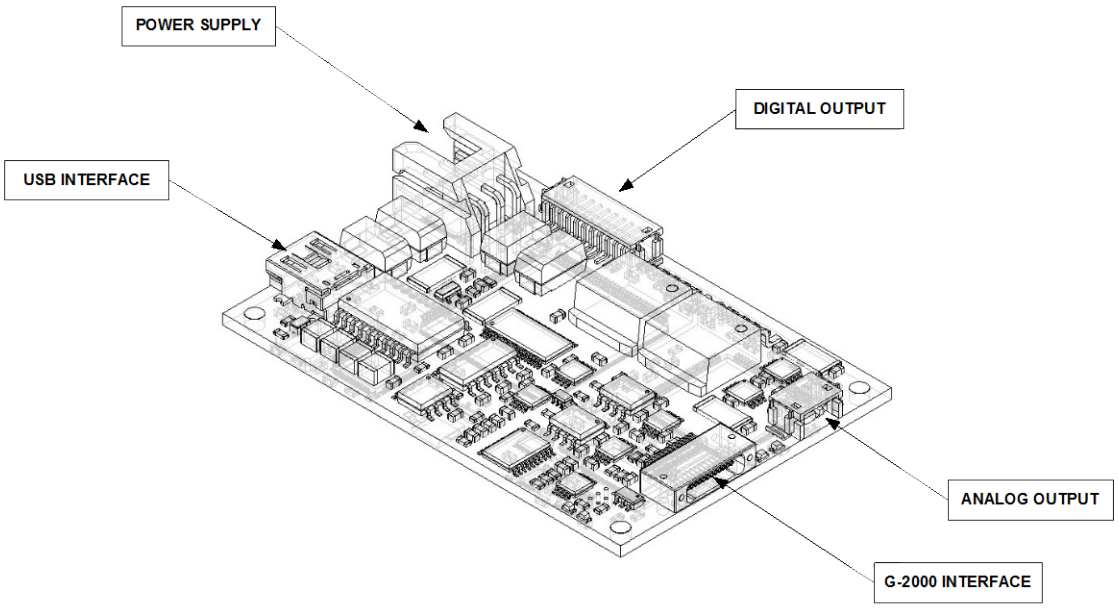

Figure 9 Electrical Interfaces

1.4.1 POWER SUPPLY INTERFACE

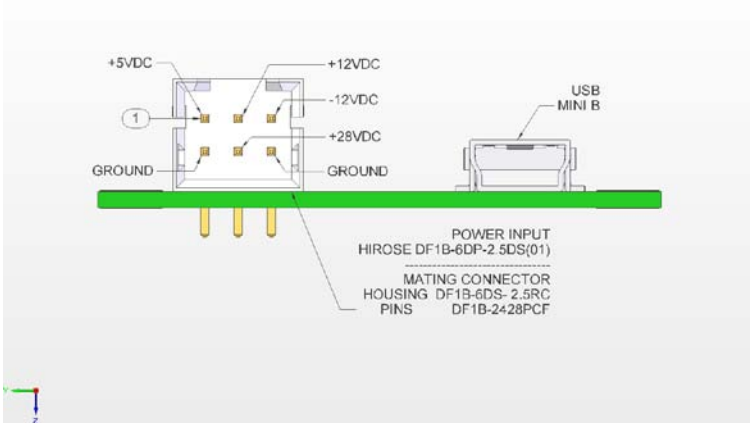

Figure 10 Power Supply Connector, Illustration

Part Number	Description
DF1B – 6DP – 2.5DS(01)	Board Connector
DF1B – 6DS – 2.5RC	Mating Connector
DF1B – 2022SCA	CRIMP PIN 20 – 22AGW
DF1B – 2428SCA	CRIMP PIN 24 – 28AGW

Pin Number	Description
1	+5Vdc
2	GROUND
3	+12Vdc to 18Vdc
4	+28Vdc
5	-12Vdc to 18Vdc
6	GROUND

1.4.2 ANALOG INTERFACE

The analog outputs are scaled ±10V for an associated rate input of ±200°/sec.

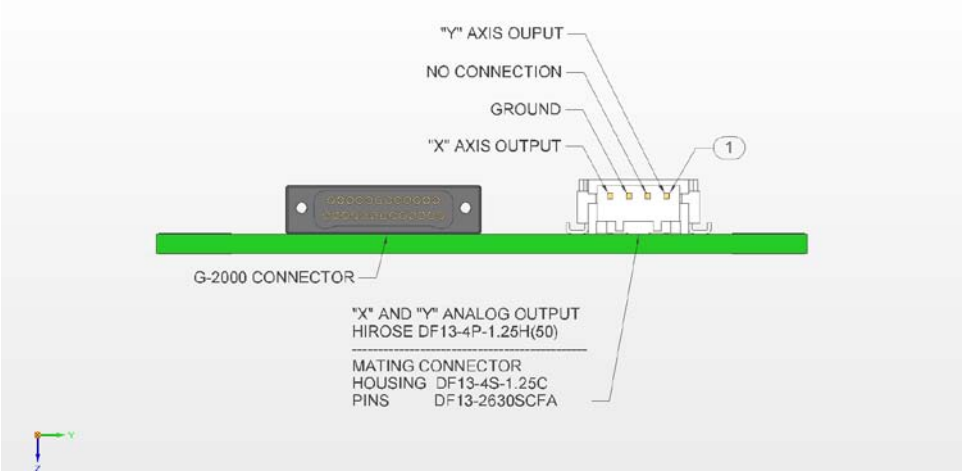

Figure 11 Analog Output Connector

Part Number	Description
DF13 – 4P – 1.25H(50)	Board Connector
DF13 – 4S – 1.25C	Mating Connector
DF13 – 2630SCFA	CRIMP PIN

Pin Number	Description
1	YAW
2	NO CONNECTION
3	SIGNAL GROUND
4	PITCH

1.4.3 DIGITAL INTERFACE

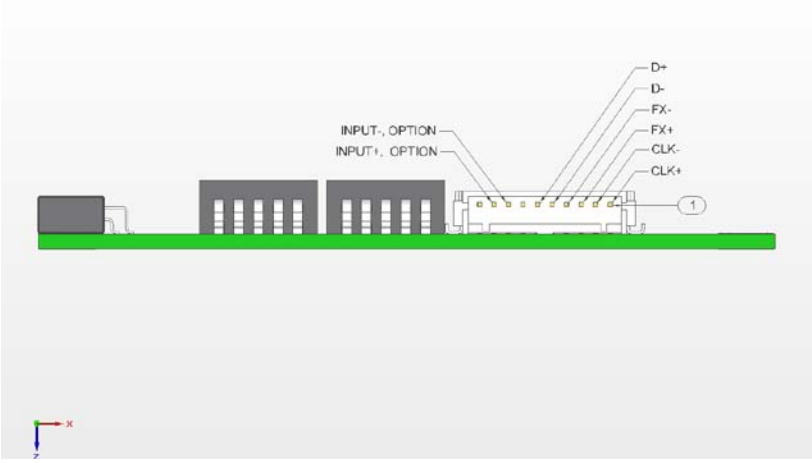

Figure 12 Digital Output Connector

The digital format consists of two 16bit signed values, one for pitch, and the other for yaw. The digital values are sent as a single 32-bit digital word using the high speed serial peripheral interface (SPI) of the TMS320VC33 DSP. The digital interface conforms to the low voltage differential signaling (LVDS[1]) standard.

- Clock Rate: 7.5 Mhz
- Word Output Rate: 21.6Khz
- Bit Width: 133.3ns/bit

Part Number	Description
DF13 – 10P – 1.25H(50)	Board Connector
DF13 – 10S – 1.25C	Mating Connector
DF13 – 2630SCFA	CRIMP PIN

Pin Number	Description
1	DSP CLK+
2	DSP CLK-
3	DSP FSX0+
4	DSP FSX0-
5	DSP Data-
6	DSP Data+
7	NO CONNECTION
8	INPUT- OPTION
9	INPUT+ OPTION
10	NO CONNECTION

[1] American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronics Industries Alliance (EIA)-664-1995 standard specifying the physical layer defining the driver and receiver characteristics.

1.4.3.1 DATA FORMAT

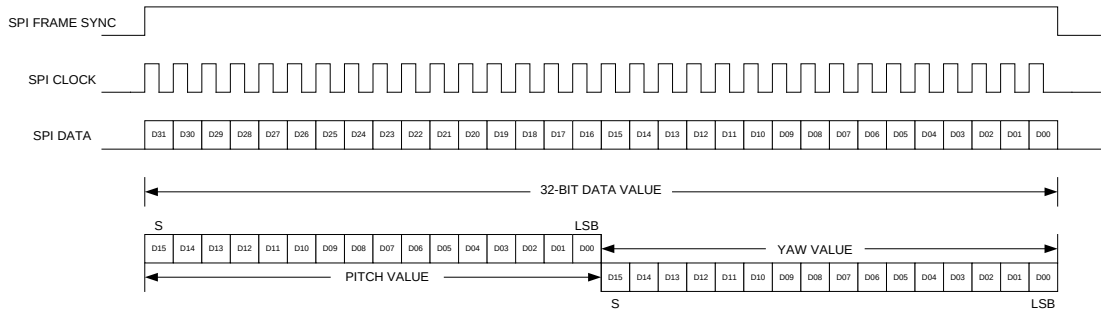

Figure 13 Digital Output, SPI Data Format

Data is valid when FSI is logic "1". Data is sampled on the rising edge of the SPI clock. There are 32bits per transfer. The first 16bits are a 2's complements PITCH value; the second 16bits are the 2's complement YAW value.

1.4.4 USB INTERFACE

The USB connector is used to upload software and configure the GCU unit parameters.

1.4.5 G-2000 INTERFACE

The Gyro Connector interfaces the G-2000 gyro to the GCU unit.

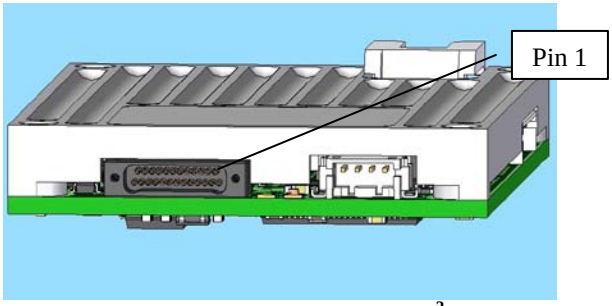

Figure 14 G-2000 Connector[2]

[2] *Note: A 0.035" Hex-Allen wrench is required to connect/disconnect the gyro from the GCU module.*

Part Number	Description
STM025L2HN	Nanonics PN (Metal)
STL025L2HN	Nanonics PN (Plastic)
4-1589483-5	Tyco PN(Metal)
1-1589483-7	Tyco PN(Plastic)

Pin Number	Description
1	SPIN MOTOR A HI
2	SPIN MOTOR A LO
3	+15Vdc
4	GROUND
5	EXCITATION HI
6	EXCITATION LO
7	Y TORQUE LO
8	Y TORQUE HI
9	X TORQUE LO
10	X TORQUE HI
11	X PICKOFF
12	Y PICKOFF
13	SPIN MOTOR B HI
14	SPIN MOTOR B LO
15	CASE GROUND
16	-15Vdc
17	NO CONNECTION (NC)
18	NO CONNECTION (NC)
19	NO CONNECTION (NC)
20	NO CONNECTION (NC)
21	NO CONNECTION (NC)
22	NO CONNECTION (NC)
23	NO CONNECTION (NC)
24	NO CONNECTION (NC)
25	NO CONNECTION (NC)

2 SETUP

WARNING!!!

The GCU unit should be setup in the following order, failure to do so could result in damaging the GCU module and or the gyroscope unit.

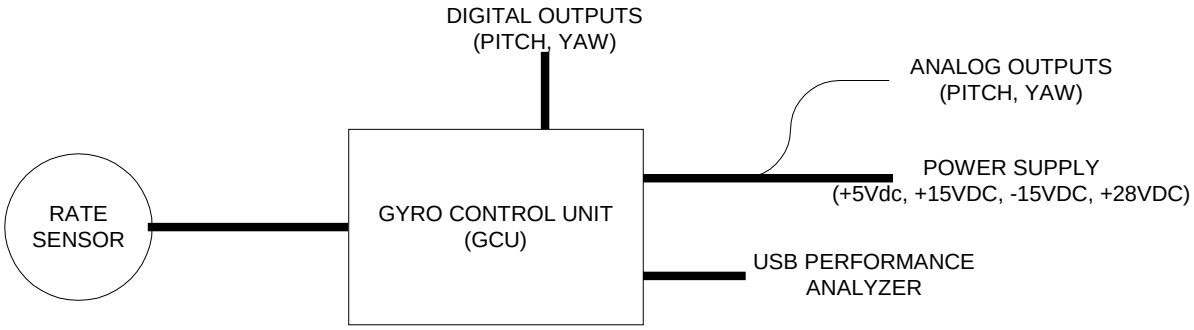

Figure 15 GCU Interface Connectors

1. Connect the gyroscope securely to the gyro control unit, before make any of the other connections.
2. Connect the USB connection to the PC.
3. Connect the Digital Output connector (if utilized).
4. Connect the Power Supply (power turn off).
5. Apply Power.

CAUTION!!! CAUTION!!! CAUTION!!!

DO NOT OVER TIGHTEN THE HEX MOUNTING HARDWARE at the G-2000/GCU interface. OVER-TIGHTENING these screws will permanently damage the GCU connector.

WARNING!!!

The power connector should be mated before the power is applied (i.e., Do NOT hot swap the connector).

3 APPLYING POWER

WARNING!!!

The user should verify the power supplies are correctly adjusted and the power is properly connected before applying power to the GCU unit. Failure to due so can damage the GCU unit and/or the gyroscope beyond repair!

Before applying power the users should verify the appropriate voltages appear on the correct interfaces pins of the power supply connector. After applying power, the gyroscope should immediately spin up; this is indicated by the audible sound emitted from the spin motor located inside the gyroscope unit. The loop is closed ~3seconds after the spin-up cycle; the analog and digital data is available in approximately 3sec after the spin up cycle is complete.

3.1 LED STATUS INDICATORS

There are four light emitting diodes (LED) to provide status to the user. There are two LEDs dedicated to the microcontroller and two for the digital signal processor unit.

3.1.1 MICROCONTROLLER STATUS

The first LED indicates DSP program load cycle and then subsequently is used as a system heart beat indicator. The Heartbeat is typically once per second allowing the user to visually inspect that the GCU is functioning properly. The second LED is unassigned as a spare.

3.1.2 DSP STATUS

The green LED indicates the control loop is closed, the red LED indicates the control loop is open. The unit is initialized to close the loop after the boot process is complete (i.e., the Green LED is ON).

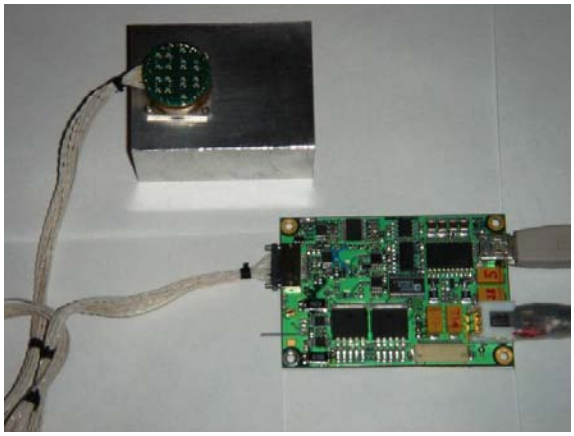

Figure 16 GCU Unit connected to the G-2000 gyro

4 PERFORMANCE ANALYZER

A Microsoft Windows compatible software application provides the user the ability to observe the G-2000 performance, as well as, adjust and store several of the key tuning parameters in the GCU FLASH memory.

Operating System Requirement:

- Windows Compatible Processing Platform running Windows XP or equivalent.

4.1 PERFORMANCE ANALYZER (GYRO SETUP PROGRAM)

The Gyro Setup program is organized as a main window with several tabs to individual functions. The application is organized into the following tabs.

1. CAL / STATUS
2. NOTCH FILTERS
3. SCOPE
4. SPECTRUM ANALYZER
5. BODE PLOT
6. LOADER

To begin, the user should select the CAL / STATUS tab and request a status report command. After doing so, the GCU should reply with the current software revisions for the individual programmable devices. The user should then request the GCU to report back the current control loop parameters by selecting the "Read Gyro Contents" command button. At this point, the Calibration Coefficients for the GCU unit are filled in for inspections. Most values can be modified and sent to the GCU module. If the user desires to save these values in the GCU flash memory they can select the "Save Calibration" command.

4.1.1 CAL/STATUS TAB

The Cal/Status tab contains the individual gyro commands to setup the control loop gains, compensation filter frequency, the ADC and DAC offset, the ADC sample delay, and specific information regarding the GCU module (i.e., serial number, DSP, PIC, FPGA firmware versions, etc.). Figure 14 shows the tab command selection and text boxes for inputting the control loop coefficients. The GCU comes from the factory with these parameters set for a particular gyro serial number. Should the GCU be associated with a different gyroscope the unit can be re-calibrated and the associated parameters store in the GCU flash memory. The GCU serial numbers are implemented using a hardware digital serial number device and therefore are unique to each GCU module manufactured.

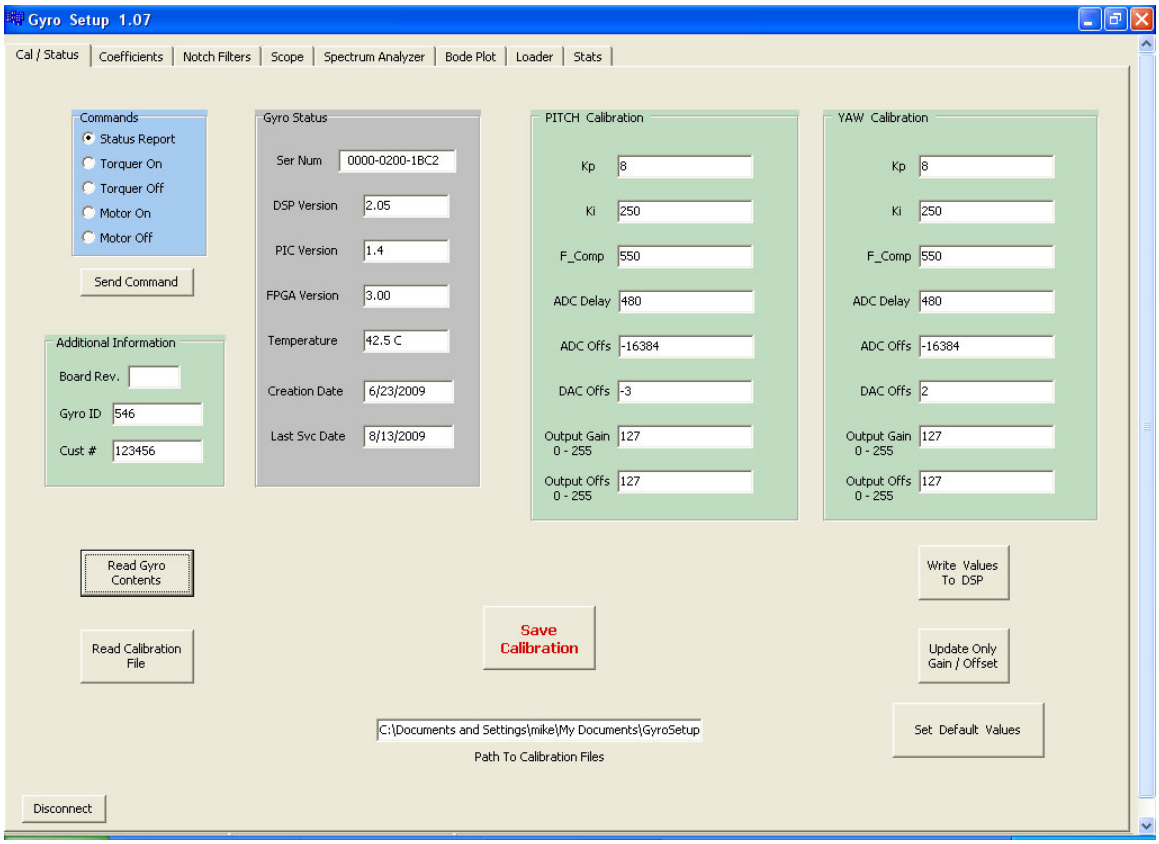

Figure 17 Cal / Status Commands, Gyro Setup

4.1.1.1 COMMANDS

The GCU can be commanded to request and status report message, turn on and off the torquer motors, on and off the spin motor (this will automatically turns off the torquer motors as well), and store the calibration values in flash memory. In normal operation the calibration values are read during power up and sent to the DSP before the loops are closed each time power is applied to the GCU unit.

4.1.1.1.1 TORQUER ON | OFF

This command turns on and off the Torquer DAC updates. When Torquer Off is selected, the torquer outputs are set to the middle range value of 0x8000 (i.e. No Torque Applied)

4.1.1.1.2 MOTOR ON | OFF

This command turns on and off the gyro spin motor. Executing this command will also turns off the torquer outputs. When the motor command is used to turn on the spin motor, the user must also send a "torquer on" command to turn back on the torquer outputs to re-establish the control loops.

4.1.1.1.3 SAVE CALIBRATION

This command stores the entire calibration coefficient field and the filter coefficient page to the GCU flash memory; overwriting the previous values. These values are used at startup and are sent to the GCU DSP after the DSP boot process. The PC application also writes a file with the GCU serial number as the filename to disk of all of the parameters stored in the GCU flash, see section 4.1.7.

4.1.1.1.3.1 Path to Save Calibration Files

This text box allows the user to set the path to save and recall the calibration files on the PC.

4.1.1.1.4 SEND COMMAND BUTTON

This button sends the selected command to the GCU.

4.1.1.1.5 ADDITIONAL INFORMATION

The additional information box allows the user to save pertinent information regarding the GCU and Gyro under test. This information will be stored in the GCU flash memory when the save calibration button is selected.

4.1.1.1.6 READ VALUES FROM DSP

This command reads the DSP control loop coefficients and places the results in their associated text boxes.

4.1.1.1.7 WRITE VALUES TO DSP

This command updates the DSP with the values in the text boxes. The Update Command does not write the values to flash memory; it only replaces the operational values so the user can assess their performance before writing them to flash. Once the user is satisfied with the performance; the "Save Calibration" command should be used to permanently store the values.

4.1.1.2 CONTROL LAW PARAMETERS

The GCU unit utilizes a proportional plus integral (PI) controller to "cage" the rotating wheel. The gyro control loop bandwidth is related to the amount of gain each of the channels contributes to the "caging" loop process. The control law parameters box allows the user to change the gains of the controller.

4.1.1.2.1 PROPORTIONAL GAIN, K_P

This text boxes allows the user to set the amount of proportional gain that should be used to control each of the separate axis.

4.1.1.2.2 INTEGRAL GAIN, K_I

This text boxes allows the user to set the amount of integral gain that should be used to control each of the separate axis.

4.1.1.2.3 COMPENSATOR FREQUENCY

This text box set the compensator cut-in frequency.

4.1.1.2.4 ADC OFFSET

This text box allows the user to trim out the Pickoff ADC offsets. The ideal setting would be 0 or exactly the mid-scale value for the signed 16bit dynamic range (+/- 32,768).

4.1.1.2.5 DAC OFFSET

This text box allows the user to trim the DC basis associated with the DAC and Power Amplifier section. The ideal setting would be 0 or exactly the mid-scale value for the signed 16bit dynamic range (+/- 32,768).

4.1.1.3 READ VALUES FROM DSP

This command button retrieves the calibration values currently used in the DSP RAM.

4.1.1.4 UPDATE VALUES

This command button sends the calibration values in the text boxes to the DSP[3] RAM.

[3] Note: the Update Values are not written to serial flash memory device, they simply overwrite the values that reside in RAM until the Save Calibration command is sent, only after that are they written to the flash memory device.

4.1.2 THE SCOPE

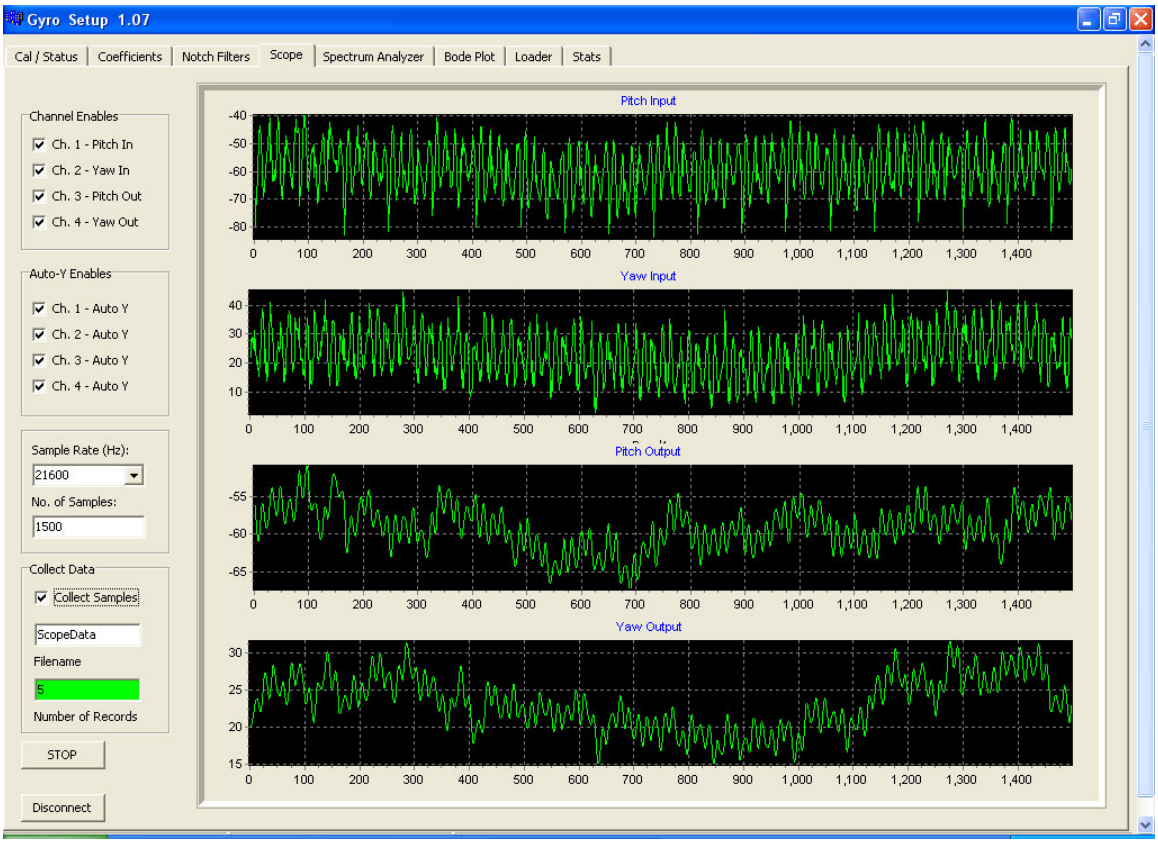

Figure 18 Oscilloscope Function, Gyro Setup

4.1.2.1 CHANNEL ENABLE

This check box allows the user to select the particular channel(s) to be displayed.

4.1.2.2 AUTO Y RANGING

This check box turns on and off the auto-range Y coordinate. When deselected the range is continually adapted to accept the largest value read.

4.1.2.3 SAMPLE RATE

This drop down selection box allows the user to select a different sample rate for each sample record.

4.1.2.4 NUMBER OF SAMPLES

This check box allows the user to set the total number of samples to collect per record.

4.1.2.5 START | STOP

The Stop/Start command starts and stops the oscilloscope traces.

4.1.2.6 CONNECT | DISCONNECT

The connect/disconnect command establishes the communication link with the USB port on the PC. Indication of the status of the communications link is given in the label fields located at the lower left-hand corner of the GCU Setup application.

4.1.3 THE SPECTRUM ANALYZER

The Spectrum Analyzer tab provides the user a full featured Spectrum Analyzer to evaluate system frequency peaks and noise in the power spectrum of the gyroscope being evaluated. This is accomplished by collecting a one second sample buffer and then calculating the power spectral density estimation (PSDE) using a Fast Fourier Transform. This allows the user to place he lowpass and notch filters in the best locations to reduce system noise in the output signals. Figure 16 shows an 800Hz peak that is not being addressed by any of the notch filters; Figure 17 illustrates the effect of placing an 800Hz notch filter to reduce this tonal.

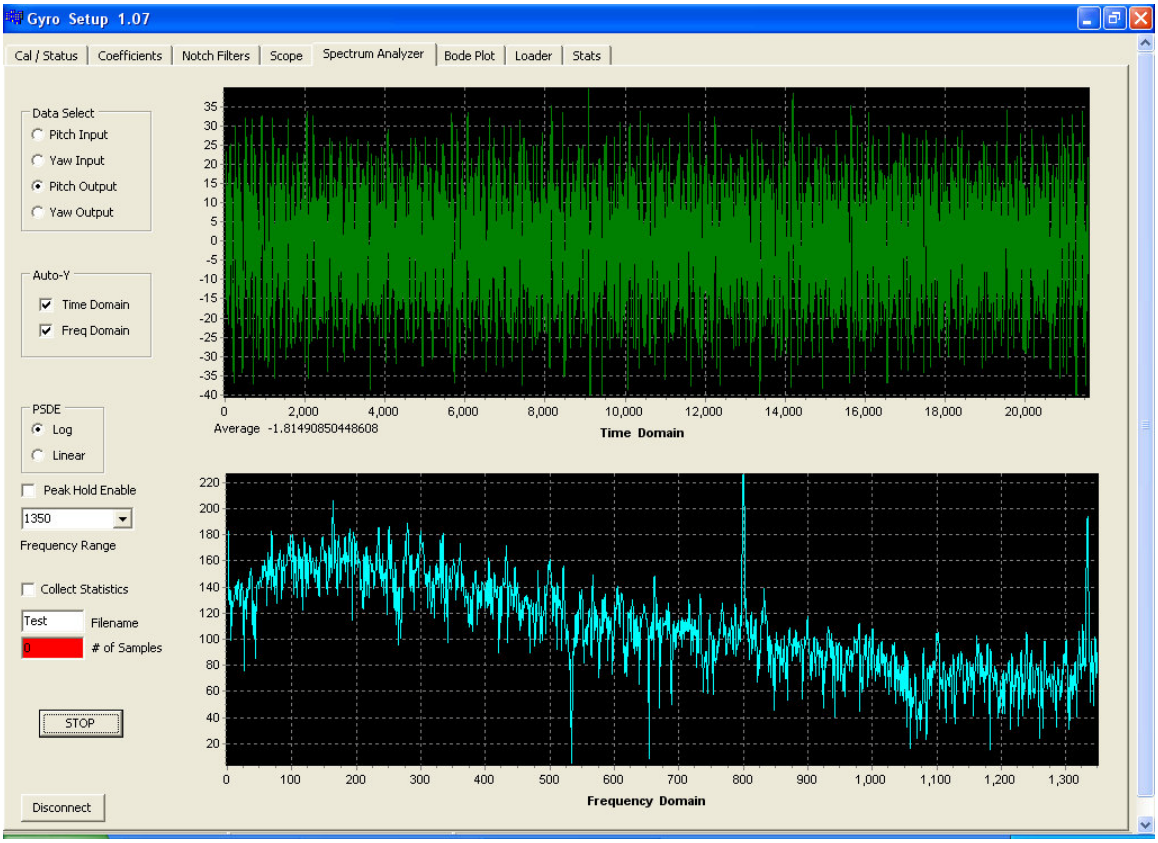

Figure 19 Spectrum Analyzer with 800Hz notch filter turn OFF

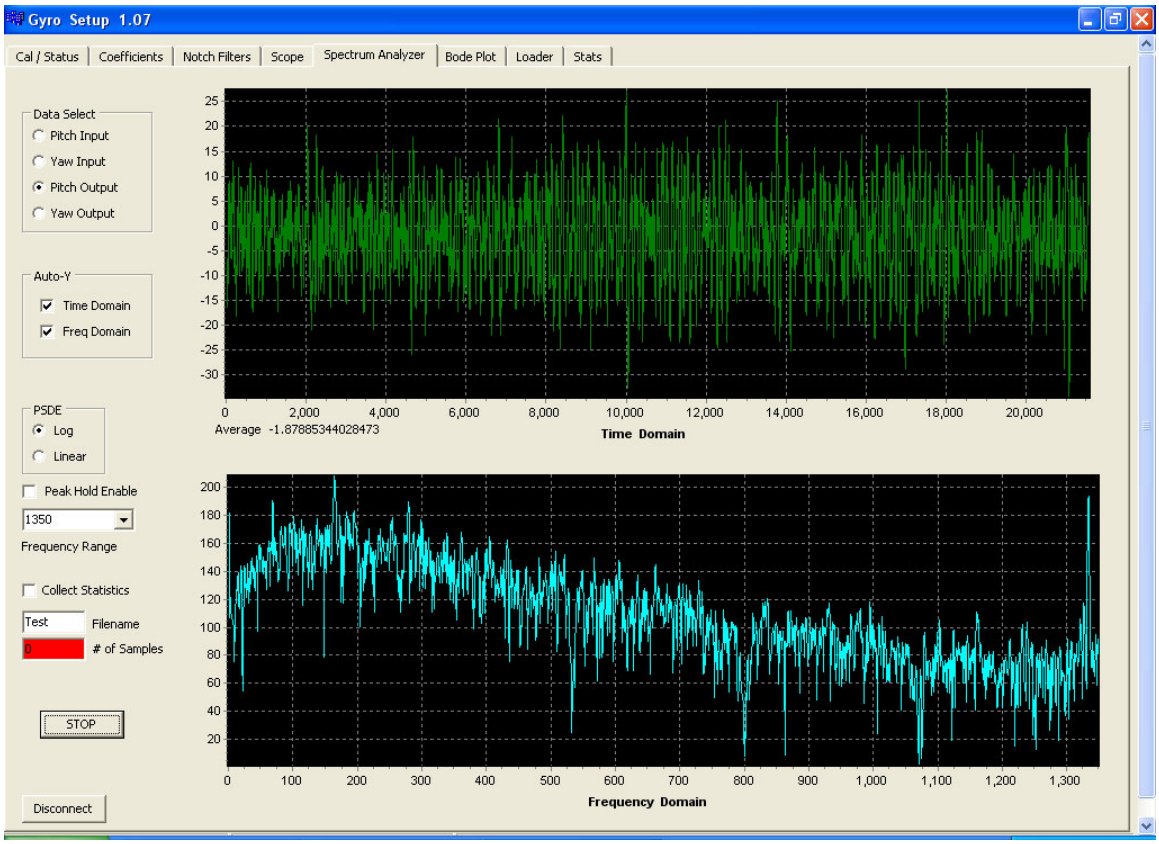

Figure 20 Spectrum Analyzer with 800Hz notch filter turned ON

4.1.3.1 DATA SELECT

The Data Select radio buttons allow the user to select the input source to the Spectrum Analyzer. The spectrum analyzer first applies a window function (i.e., Hanning Window) to the input data stream and then calculates a 32768 point FFT. The resultant power spectral density estimation (PSDE) is then calculated by taking the magnitude of the FFT complex data set and plotting it in the display.

4.1.3.2 AUTO-Y

Checking the Auto-Y selection for either the time domain or the frequency domain will automatically scale the data range in the associated graph.

4.1.3.3 PSDE

The magnitude of the power spectral density estimation can be displayed on either linear or logarithmic scale.

4.1.3.4 PEAK HOLD ENABLE

The peak hold enable plots the peaks of the PSDE output. Un-checking the option clears the Peak Hold graph. (i.e., the Magenta Plot in the spectrum window).

4.1.3.5 FREQUENCY RANGE

The frequency range drop down menu selects the frequency span from zero to the selected end frequency.

4.1.3.6 START | STOP

This button starts and stops the Spectrum Analyzer function.

4.1.4 THE BODE ANALYZER

The Bode Plot Analyzer allows the user the ability to observe the gyro performance under different control loop gain settings. The servo response or control loop bandwidth can be optimized by adjusting the proportional and integral gain settings.

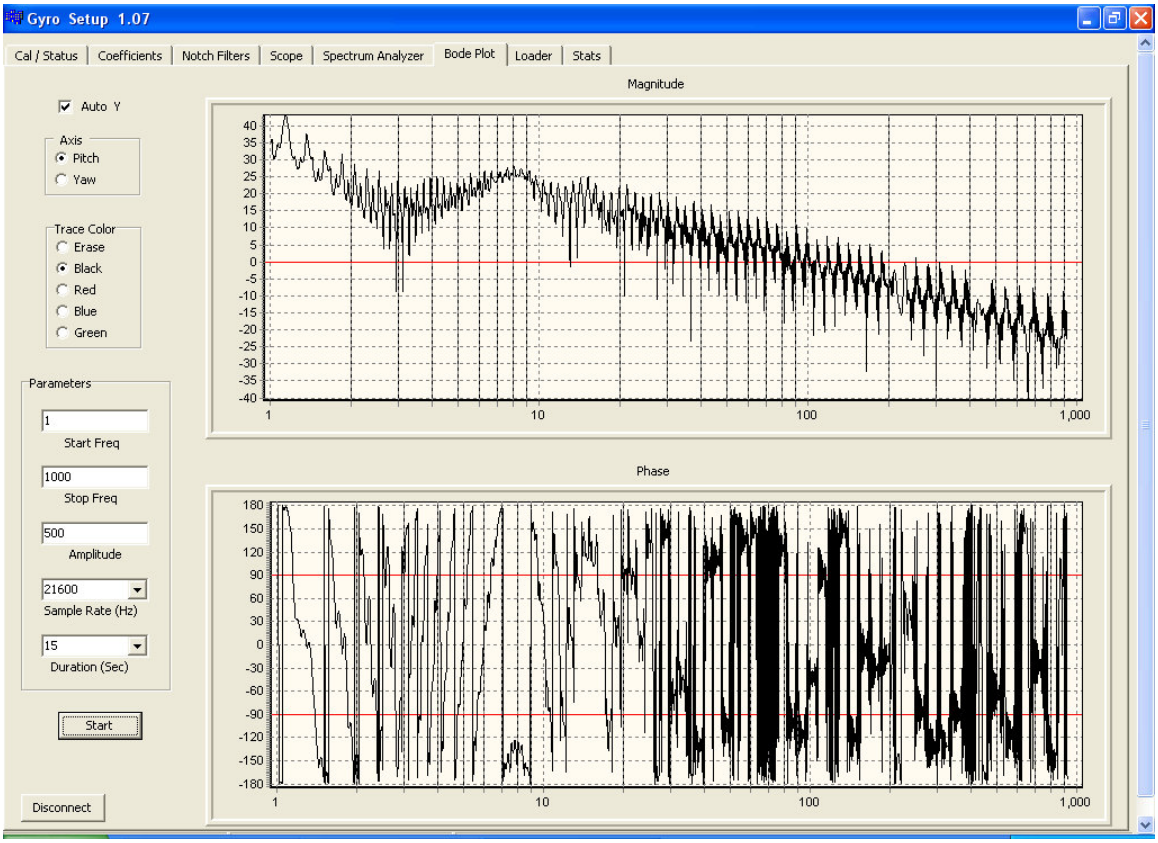

Figure 21 Open Loop Response, Bode Analyzer

Figure 18 trace shows a typical open-loop response of the control system. By adjusting the Proportional gains, Integral gains, and compensator cut-in frequencies the servo system can be designed to provide the largest bandwidth with the highest control authority while preserving the overall loop stability. *Note: changing the pen color in between different gain settings allows the user to compare the results.*

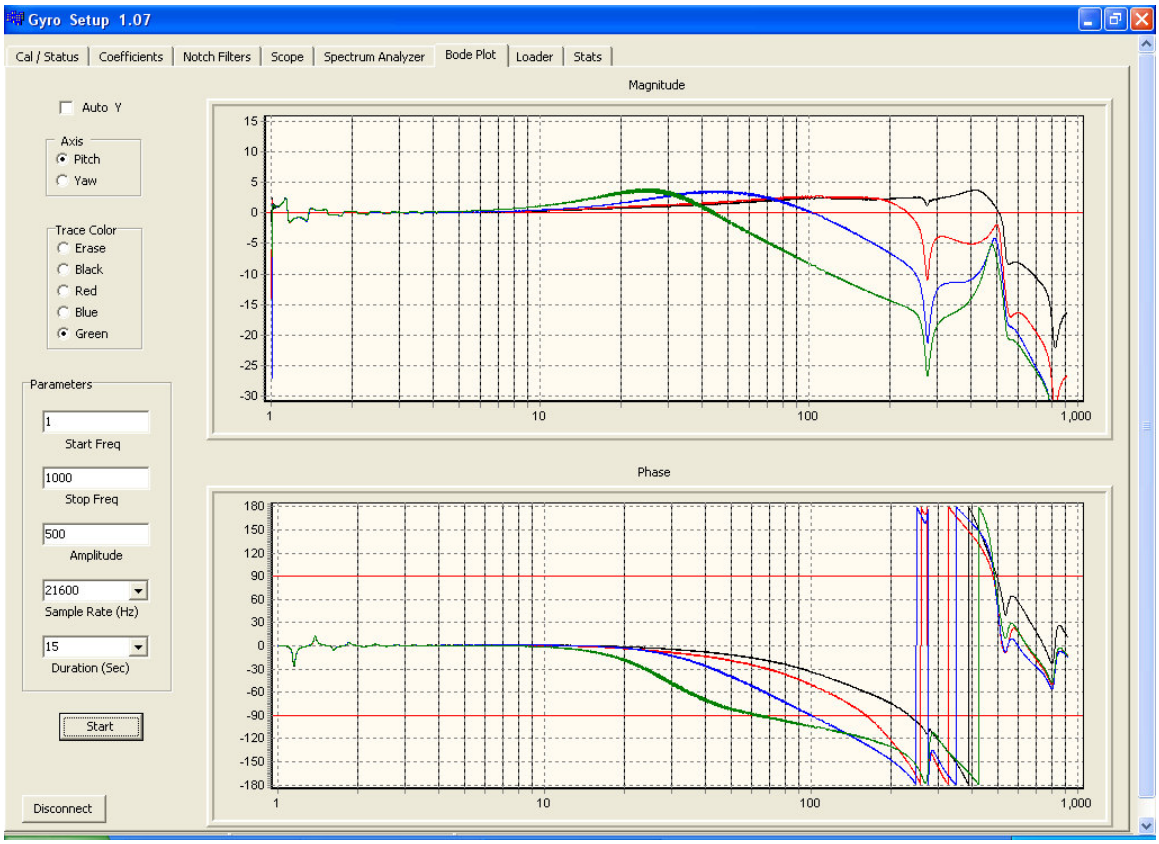

Figure 22 Bode Plot Analyzer

Figure 19 shows the several different gain setting and their effect on the Pitch channel. As the gain in increased (green, blue, red, black, increase respectively) the response in extended out to ~250Hz @ -3db where it intercepts the 266.667Hz notch filter.

4.1.4.1 HOW IT WORKS[4]

The Bode analyzer works by exciting the selected torquer axis with constant amplitude swept sinusoidal waveform while measuring the results at the pick-off coils. The amount of gyro wheel fluctuation determines how well the gyro is performing as measured by its ability to stay in phase with the excitation (i.e., the GCU's ability track the input disturbance). The heart of the bode analyzer resides inside the software of the GCU unit. The GCU unit creates the excitation waveforms, measures the pickoff values, calculates the Fourier integral values, and stores the individual values to create the report. Once the Bode function has completed the programmed frequency span and duration; it transfers the data using the USB interface to the laptop computer where the values are combined to create the magnitude and phase response of the system for plotting.

[4] Note: The user must make sure the Gyro is firmly attached to the mounting surface or held in a vise during the Bode Analyzer, the input torque of the swept sine input will cause small motions in the overall structure (i.e., the outer housing will move) which will yield poor results.

4.1.4.2 AXIS

This radio button allows the user to select either the Pitch or the Yaw axis for analysis.

4.1.4.3 TRACE COLOR

The trace color "radio buttons" allow the user to change pen colors and plot a new plot on top of an old one for comparison.

4.1.4.4 PARAMETERS

4.1.4.4.1 START FREQUENCY[5]

This text box allows the user to set the desired starting frequency in Hz of the Bode analyzer.

4.1.4.4.2 STOP FREQUENCY

This text box allows the user to set the desired stopping frequency in Hz of the Bode analyzer

4.1.4.4.3 EXCITATION AMPLITUDE[6]

The text box sets the excitation amplitude to be summed into the DAC during the Bode analysis.

4.1.4.4.4 SAMPLE RATE

This drop down list sets the sample rate of the bode process. The Fourier Integral values are calculated at this rate. The system decimates the output by a factor to allow the bode values to be stored locally in the GCU until the process is over at which time the data is sent to the PC over the USB interface.

4.1.4.4.5 DURATION

The duration box sets the test duration in seconds the sweep generator shall sweep from the start frequency to the stop frequency.

4.1.4.5 START | STOP

This button starts and stops the bode analyzer.

[5] The start and stop frequency values allow the user to zoom in on a region for inspection.
[6] Setting the Amplitude too high will cause the gyro to be unstable. This is indicated by the crashing sound of the wheel being forced against the hard stops of the gyro cage.

4.1.5 NOTCH FILTER ADJUSTMENTS

WARNING!!!

Adjusting the notch filter parameters should only be accomplished by a trained operator or someone familiar with the GCU unit and the gyroscope. Changing the notch filter placements, steepness, and/or damping coefficients can cause the system to be unstable.

The GCU unit incorporates five independent programmable digital filters to remove spectral line and noise components in the gyro signal. This is accomplished by utilizing a cascade of bilinear-quad IIR filters. The bi-quads are programmed for the type of filter, the frequency, and the bandwidth, respectively.

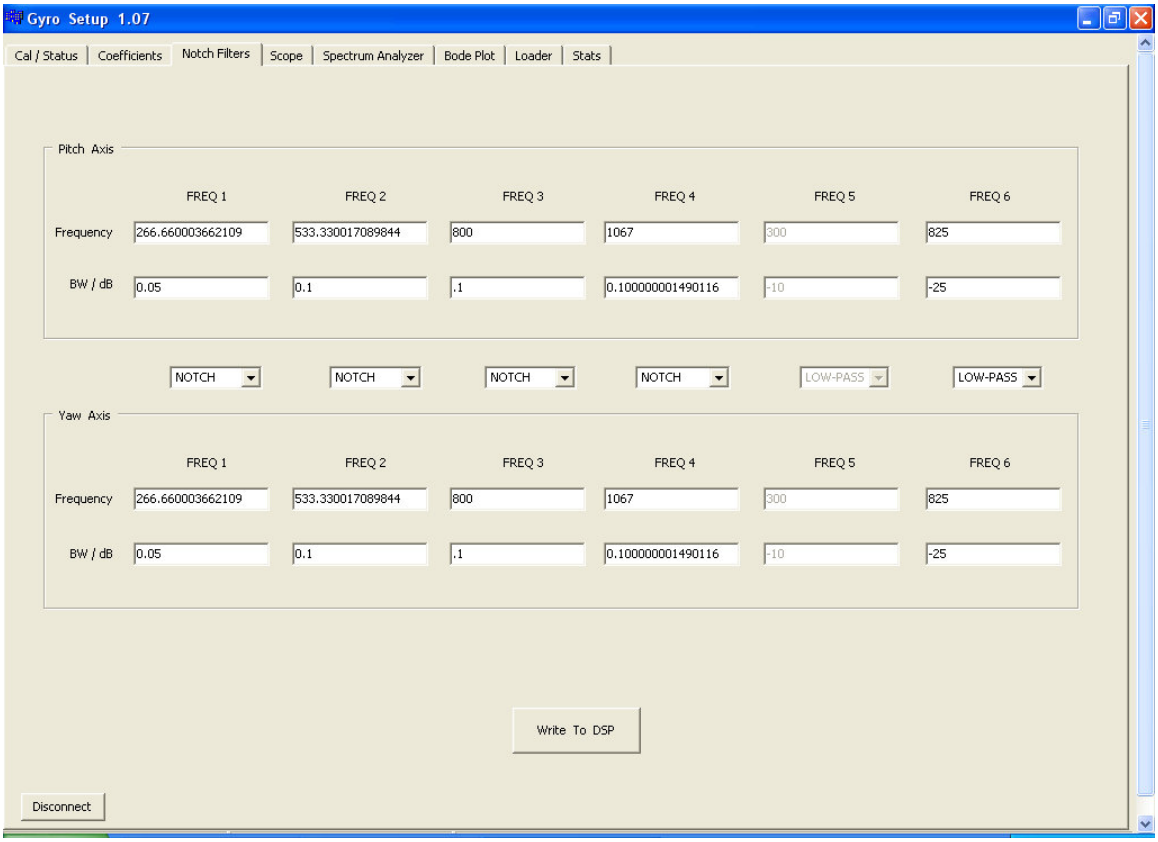

Figure 23 Notch Filter Coefficient Adjustments

4.1.5.1 WRITE TO DSP

This command stores the filter parameters in the GCU RAM. The Filter Parameters are read at power on and sent to the DSP.

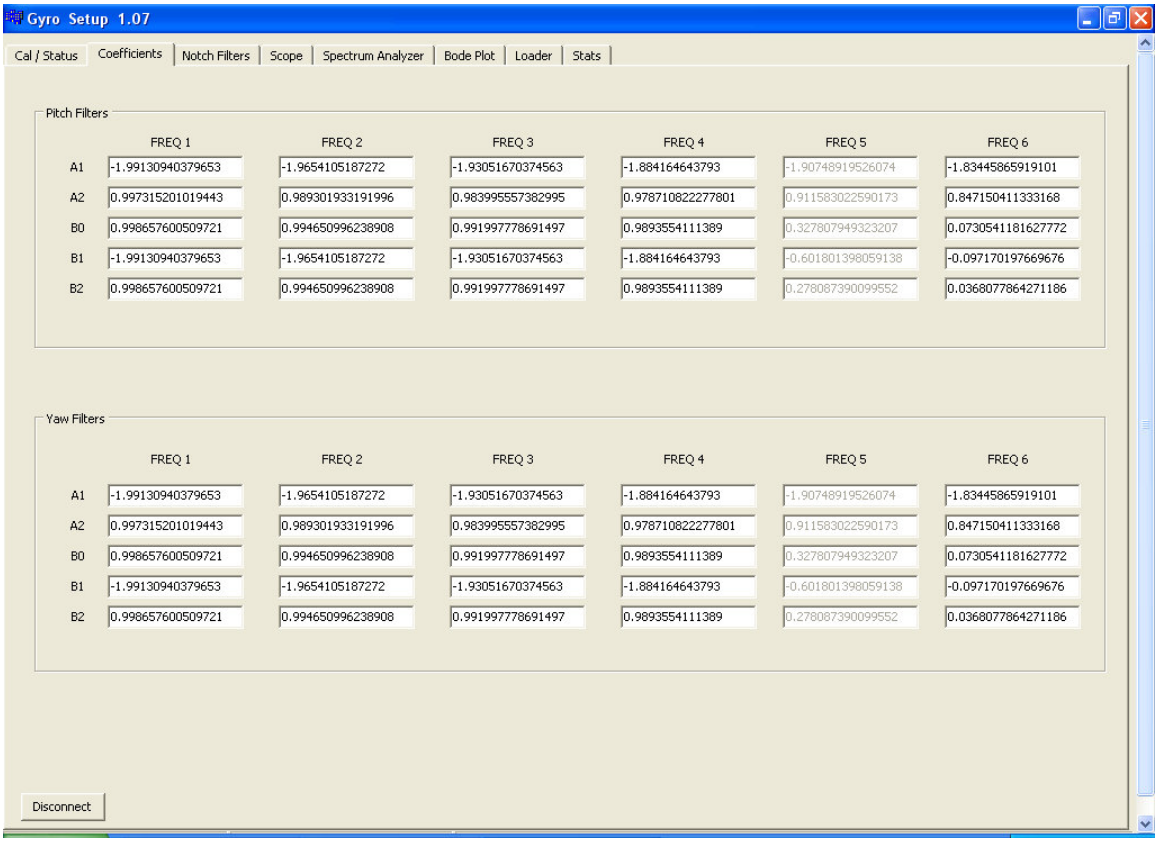

Figure 24 Filter Coefficients

Figure 21, shows the digital filter coefficients calculated from the filter selection tab. These coefficients are downloaded to the GCU and used in calculating the bi-quad filter responses. They are not editable and are simply presented as information for the user.

4.1.6 FIRMWARE LOADER

The firmware for the microcontroller and digital signal processor are completely downloadable using a standard windows laptop using a USB interface. The USB interface is connected with the standard USB cable P/N, descriptor… The USB drivers are included on the distribution disk or downloadable from the MaxMetrix website (i.e. www.maxmetrix.com).

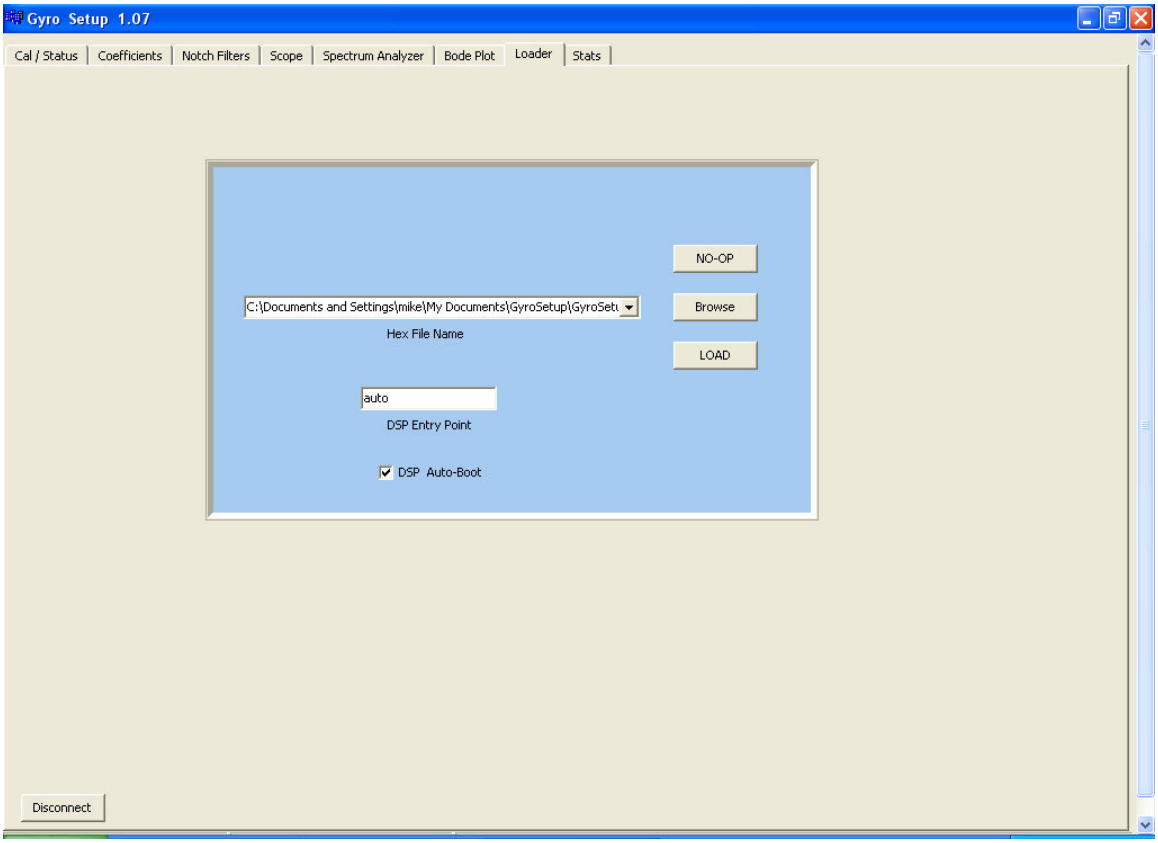

Figure 25 Firmware Loader Application

4.1.6.1 BROWSE

The BROWSE command button allows the user to traverse the windows directory structure to find the appropriate file to download.

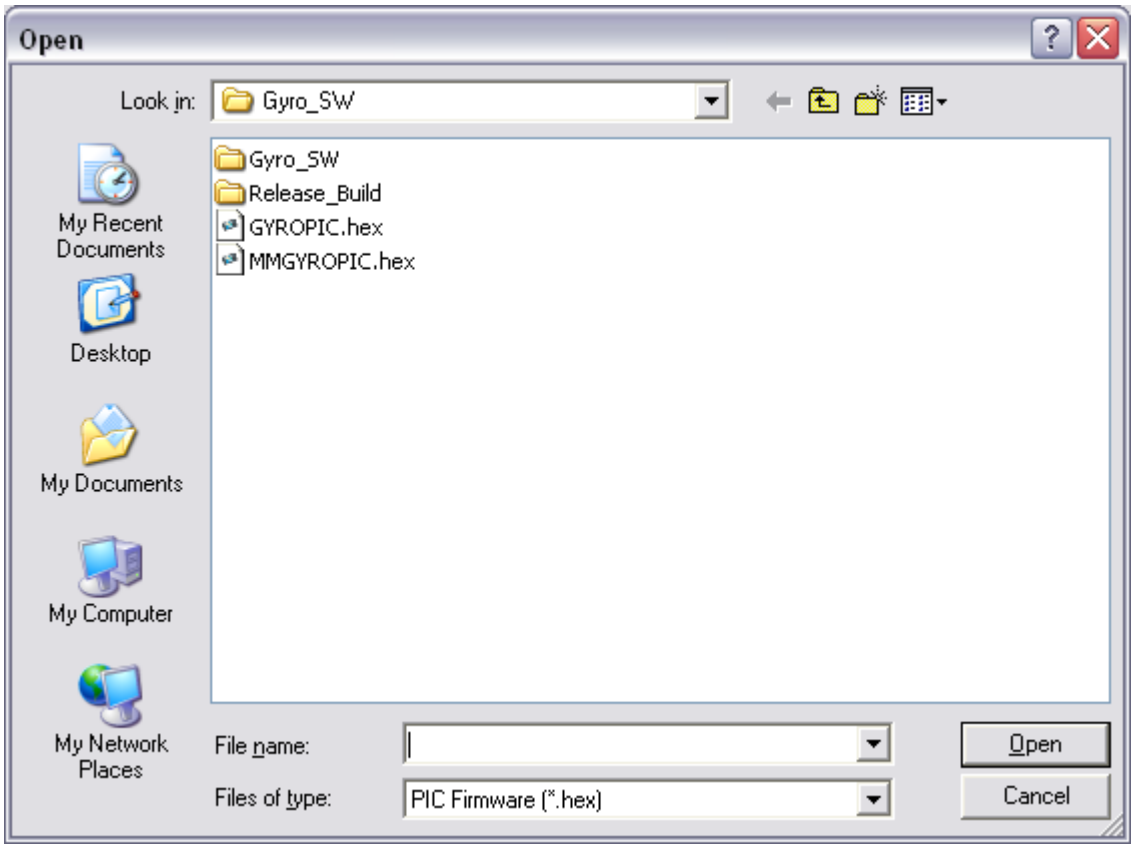

Figure 26. Browse File Function, Graphical User Interface (GUI)

The **File of type** selector allows the user to filter for the desired extension. The available extensions are as follows:

Extension	Description
.hex	Microcontroller Firmware
.m0	DSP Firmware

Table 1. Available Firmware Files, Extension(s)

4.1.6.2 LOAD

The LOAD command button downloads starts the download of the selected file. Progress of the download is displayed as a percentage from 0-100%. When the percentage equals 100% the download is complete. The user should disconnect the USB interface cable and cycle the power supply. After the power has been cycled the microcontroller reloads the DSP with the new firmware.

The user should verify the new firmware has been downloaded by executing the Status Report command button and review the reported firmware ID.

4.1.6.3 NO-OP

The NO-OP (no operation) command button tests the communications link with the microcontroller on the GCU. If the link is valid a message is displayed indicating the link PASSED. If the application is unable to establish communications with the GCU unit the message displays FAILED.

4.1.6.4 DSP ENTRY POINT

The DSP Entry Point Text Box sets the starting address for the DSP Code. "AUTO" automatically finds the address in the object code file. The User can specify this address manually if desired.

4.1.6.5 AUTOBOOT ENABLE

The Auto-boot enable checkbox allows the user to disable/enable the microcontroller autoboot function. During normal operation, if the microcontroller does not get a good status reply from the DSP it will try and reboot the DSP from FLASH continuously. During Debug the autoboot function conflicts with the DSP in-circuit emulator. Disabling the autoboot enable function (by unchecking autoboot) disables the microcontroller from rebooting the DSP, allowing the debug session to resume normally. The autoboot function should be enabled for normal operation.

4.1.6.6 FIRMWARE RELEASE LEVEL

The firmware revision numbers can be determined using the Status Report selection radio button located on the Cal/Status Tab. The current revision information is reported back to the GUI for inspection.

4.1.6.7 TROUBLESHOOTING THE LINK[7]

There are several reasons for the communications link to report a "FAILED" message, some of the most common are provided below:

- Power not applied to the GCU unit, power must be applied to download a GCU module.
- Wrong serial port selected. The USB is used as a virtual serial communication port. Make sure the correct port is selected in the PORTS pull down menu.
- Wrong USB cable type or cable not connected

[7] The user should always test the communications link by selecting the NO-OP command button and getting a PASSED message before trying to download the GCU with new firmware.

4.1.7 MANUFACTURING REPORT

The software automatically generates a text file with all of the associated information regarding the parameters and setup of the GCU unit. Additional information regarding the "Born on Date" (i.e., the date the GCU was created), the associated Gyroscope Serial Number, the last date and time the GCU was configured, etc. is contained in this report. All of the information is stored in the Flash Memory located on the GCU unit.

Sample Report Format:

[Info]
Item=Gyro Control Electronics
Mfr=MaxMetrix, Inc.
Board_Rev=101
SerNo= 0000-0143-ED88
DSP_Vers=1.07
PIC_Vers=0.6
FPGA_Vers=2.01
Build_Date= 6/2/2008
Modify_Date= 7/13/2008
Gyro_ID=546
Cust_No=123456
Pitch_Kp=1.70000004768372
Pitch_Ki=170
Pitch_Fc=1200
Pitch_ADCD=1200
Pitch_ADC=-4165.61376953125
Pitch_DAC=-18
Yaw_Kp=1.70000004768372
Yaw_Ki=170
Yaw_Fc=1200
Yaw_ADCD=1200
Yaw_ADC=-13577.31640625
Yaw_DAC=-18
Pitch_F1_c1=-1.94634687900543
Pitch_F1_c2=0.985019207000732
Pitch_F1_c3=-1121.1767578125
Pitch_F1_c4=-1127.64306640625
Pitch_F1_c5=0.984716534614563
Pitch_F2_c1=-1.96541003649788
Pitch_F2_c2=0.98930185116705
Pitch_F2_c3=0.99465092558353
Pitch_F2_c4=-1.96541003649788
Pitch_F2_c5=0.99465092558353
Pitch_F3_c1=-1.98863859783394
Pitch_F3_c2=0.99463658740128
Pitch_F3_c3=0.99731829370064
Pitch_F3_c4=-1.98863859783394
Pitch_F3_c5=0.99731829370064
Pitch_F4_c1=-1.93051669200337

Pitch_F4_c2=0.98399554879006
Pitch_F4_c3=0.99199777439503
Pitch_F4_c4=-1.93051669200337
Pitch_F4_c5=0.99199777439503
Pitch_F5_c1=-1.97849669083323
Pitch_F5_c2=0.99196564994852
Pitch_F5_c3=0.99598282497426
Pitch_F5_c4=-1.97849669083323
Pitch_F5_c5=0.99598282497426
Pitch_F6_c1=-1.91665852069855
Pitch_F6_c2=0.919996082782745
Pitch_F6_c3=0.000834393780678511
Pitch_F6_c4=0.00166878756135702
Pitch_F6_c5=0.000834393780678511
Yaw_F1_c1=-1.94634687900543
Yaw_F1_c2=0.985019207000732
Yaw_F1_c3=523.616455078125
Yaw_F1_c4=557.407958984375
Yaw_F1_c5=0.984716534614563
Yaw_F2_c1=-1.96541003649788
Yaw_F2_c2=0.98930185116705
Yaw_F2_c3=0.99465092558353
Yaw_F2_c4=-1.96541003649788
Yaw_F2_c5=0.99465092558353
Yaw_F3_c1=-1.98863859783394
Yaw_F3_c2=0.99463658740128
Yaw_F3_c3=0.99731829370064
Yaw_F3_c4=-1.98863859783394
Yaw_F3_c5=0.99731829370064
Yaw_F4_c1=-1.93051669200337
Yaw_F4_c2=0.98399554879006
Yaw_F4_c3=0.99199777439503
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Yaw_F4_c5=0.99199777439503
Yaw_F5_c1=-1.97849669083323
Yaw_F5_c2=0.99196564994852
Yaw_F5_c3=0.99598282497426
Yaw_F5_c4=-1.97849669083323
Yaw_F5_c5=0.99598282497426
Yaw_F6_c1=-1.91665852069855
Yaw_F6_c2=0.919996082782745
Yaw_F6_c3=0.000834393780678511
Yaw_F6_c4=0.00166878756135702
Yaw_F6_c5=0.000834393780678511
End_Of_File=here

4.2 PARAMETER BUTTONS AND STORAGE

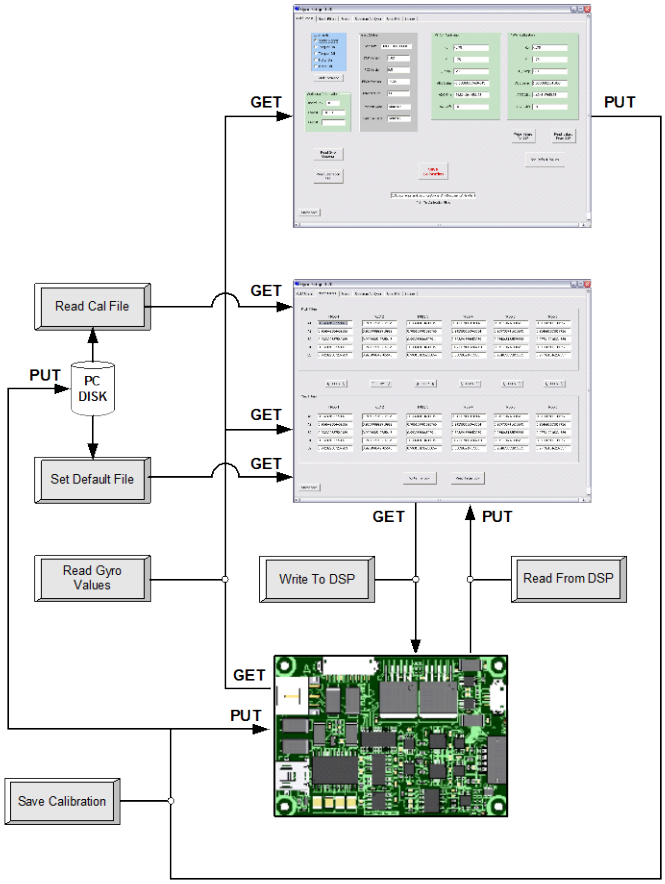

Table 2 Parameter Button Usage

Button	Description
Read Calibration	Reads the calibration file named with the filename associated with the serial number (i.e., G-0000-0000-0000.dat) from of the associated GCU. *Note: the zeros in the example will actually be the unique serial number reported back from the specific GCU module.*
Set Defaults	Reads the default values file named "defaults.dat"
Read Gyro Contents	Reads the values from the GCU module FLASH memory.
Save Calibration	Saves the current values in the CAL/STATUS and FILTERS TAB and stores them in the FLASH memory on the GCU and writes them to the file on the test computer with the filename of the associated serial number from of CGU.
Write to DSP	Writes the current values from the GUI to the DSP RAM. *Note: they are only in RAM, they will not remain after power is turned off. To make them permanent the user must select the Save Calibration Button.*
Read From DSP	Read the current values from the DSP RAM and updates the text boxes in the filter TAB.

Table 3 Parameter Button Usage

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Maxmetrix, LLC.
7119 E Shea Blvd 109-417
Scottsdale, AZ 85254 USA

6 FAQ AND TECHNICAL SUPPORT

The section presents some of the possible remedies to different issues that may occur while exercising the unit with the gyro setup application.

6.1 GYRO SETUP SOFTWARE DOES NOT RESPOND TO COMMANDS

- Try to disconnect and then reconnect the USB service using the CONNECT button in the Gyro Setup application.
- Try to reboot the Windows PC, then restarting the Gyro Setup application

6.2 G-2000 GYRO IS UNSTABLE AFTER POWER IS APPLIED[8]

This can occur if the wrong parameters are loaded in the GCU flash memory.

- Power the unit on.
- Connect to the GCU with the Gyro Setup application and send a MOTOR OFF command. This will turn off the spin motor and torquer outputs.
- Load the default parameter file, using the SET DAFAULT VALUES button.
- Send to defaults to the GCU DSP using the "SEND TO DSP" button
- Turn on the spin motor and send a TORQUER ON command. If the gyro is stable and caged, then use the SAVE CALIBRATION button to write the parameters to the Flash memory in the GCU.
- Re-Tune the Gyro parameters, and then SAVE CALIBRATION to write the new parameters to Flash.

CAUTION!!! CAUTION!!! CAUTION!!!

If the gyro is unstable after power is applied the GCU and Gyro will get very hot due to excessive torque being applied by the controller. It is very important to turn off the spin motor as soon as possible to prevent over the GCU and Gyro from over heating.

CAUTION!!! CAUTION!!! CAUTION!!!

6.3 GYRO NOT CAGING

- Check to see if the DSP control law active LED is illuminated (lights ~3sec after power is applied), if not, download the DSP code using the firmware loader.

[8] If the gyro is unstable after power on the GCU and Gyro will get very hot due to excessive torque being applied b the controller. It is very important to turn off the spin motor as soon as possible to prevent over heating of the unit.

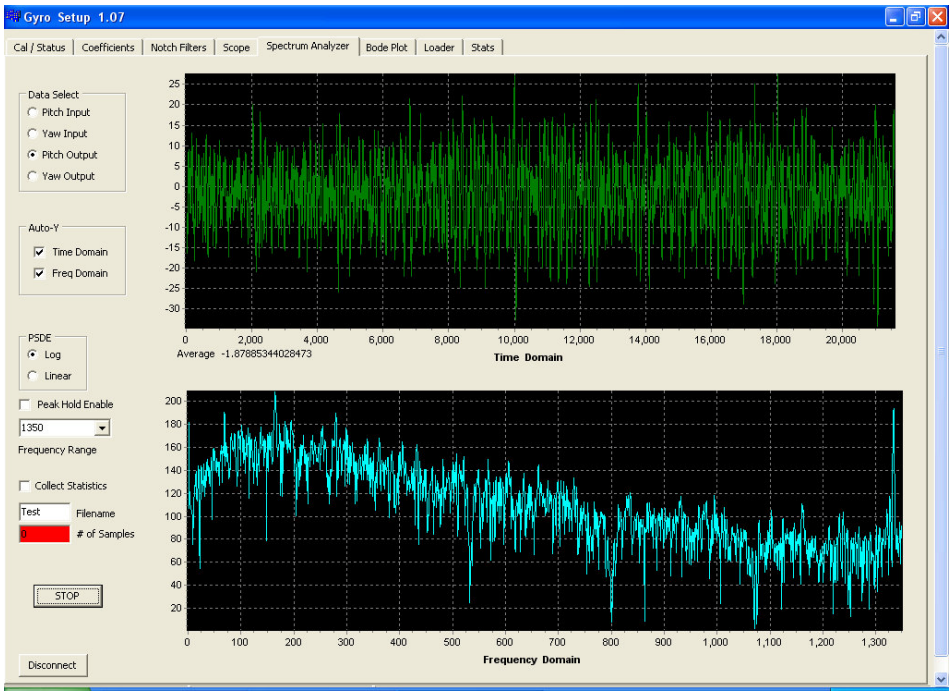


Figure 27 Examples of a nicely tune system, Spectrum Plot

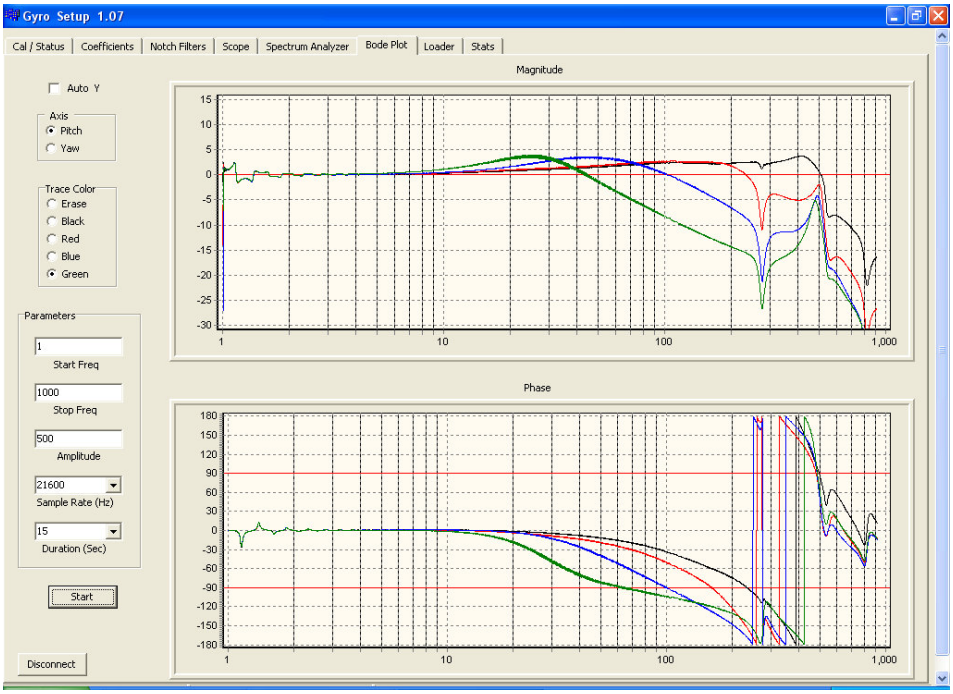


Figure 28 Examples of a nicely tuned system, Bode Plot

GCU2K1 Specifications

6.4 MECHANICAL DIMENSIONS

Description	Dimension
Width	63.5 x 43.2 x 7.62mm (2.5" x 1.7" x 0.3")
Weight	94 grams (3.2 ounces)
Mounting Holes	#2 SAE hardware

Table 4 Mechanical Dimensions

6.5 ELECTRICAL SPECIFICATIONS

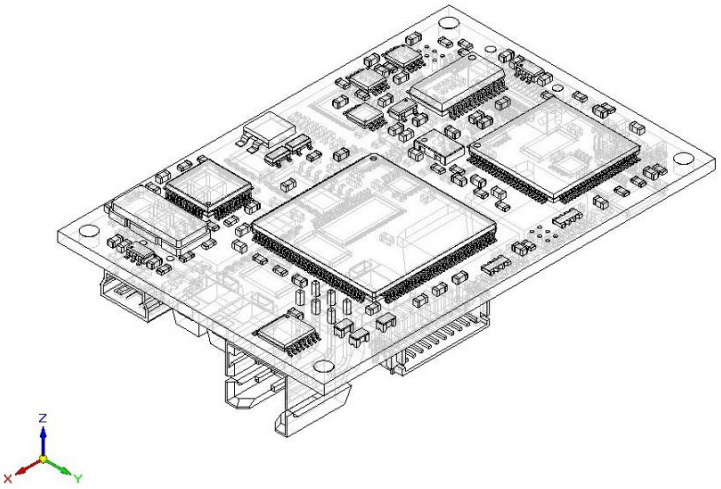
Description	Specification
Voltage(s)	+28Vdc[9] or +5V +/-15V
Current(s)	240ma (idle) to 500ma (max. rate)
Gyro Control Loop Bandwidth	200hz (typical)
Maximum Rate Response	150deg/sec

Table 5 Electrical Specifications

6.6 ENVIRONMENTAL SPECIFICATION

Description	Specification
Operating Limits	-40 to +80deg C
Relative Humidity	0 to +95 % relative humidity (non condensing)
Storage Limits	Same and Operating

Table 6 Environmental Specifications



[9] When used with the optional DC-DC converter GCU2K1-PS